CLAIMS

The embodiment of the invention in which an exclusive property or privilege is claimed is defined as follows:

1. An improved electrolyte for the electrolysis of alumina (Al_2O_3), the electrolyte comprising a mixture of aluminum fluoride (AlF_3) and potassium fluoride (KF).

2. The electrolyte recited in claim 1 wherein the aluminum fluoride (AlF_3) is present in a molar ratio with potassium fluoride (KF) greater than 1:1.

3. The electrolyte recited in claim 1, the electrolyte further comprising from about 2 to 6 wt. % of aluminum oxide (alumina/Al_2O_3).

4. The electrolyte as recited in claim 1 wherein the concentrations of the electrolyte's components remain constant during electrolysis.

5. The electrolyte as recited in claim 1 where the electrolyte is used to electrolyze the alumina to aluminum at from about 660^{0}C to 1000^{0}C.

6. The electrolyte as recited in claim 3 wherein the electrolyte remains liquid during electrolysis.

7. The electrolyte as recited in claim 6 wherein inert anodes and wettable cathodes can be used with the electrolyte.

8. A method for using inert anodes and wettable cathodes in the electrolytic production of aluminum comprising using the anodes and cathodes in an electrolysis process at a temperature from between 660°C and 1000°C.

9. The method as recited in claim 8 wherein the anode is comprised of a material selected from the group consisting of metals, metal alloys, metal oxides, and cermets.

10. The method as recited in claim 8 wherein the alloys are copper alloys (aluminum-bronze) and are from about 1 wt.% to 20 wt.% aluminum (Al).

11. The method as recited in claim 8 wherein the cathode is made of a material selected from the group consisting of metal borides, metal boride-carbon composites, metal boride-containing coatings on substrates, graphite, molybdenum, and tungsten.

12. The method as recited in claim 8 where the anode contains an oxygen-containing film.

13. The method as recited in claim 12 wherein the oxygen containing film is formed during the electrolysis process.

14. The method as recited in claim 11 wherein the material coats one side of the inert anode to create a bipolar electrode for use in multipolar electrolytic cells.

15. The method as recited in claim 8 wherein the distance between the anode and cathode remains constant.

16. The method as recited in claim 8 wherein the electrodes can be arranged in a vertical configuration.

17. The method as recited in claim 8 wherein the electrodes can be arranged in a slanted configuration.

18. The method as recited in claim 8 wherein O_2 is the only gas generated by electrolysis.

19. The method as recited in claim 16 wherein the vertical configuration of the cell creates electrolyte recirculation pathways.

20. A method for electrolyzing alumina below 1000°C, the method comprising:

a) supplying an electrolyte containing more than 35 mol% potassium fluoride (KF) and more than 30 mol% aluminum fluoride (AlF_3);

b) injecting alumina with the electrolyte; and

c) subjecting the electrolyte to a voltage.